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(71) Applicant
Telaction Corporation

(Incorporated in USA-Delaware)

One Century Centre, 1750 East Golf Road,
Schaumburg, Illinois 60173-5002,
United States of America

(72) Inventors
Karl W McCalley
Steven D Wilson
James L Fischer

(74) Agent and/or Address for Service
Raworth Moss & Cook
36 Sydenham Road, Croydon, Surrey, CR0 2EF

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(54) Digital interactive communication system

(57) In a digital interactive communication system subscribers can select by means of their touch-tone telephones any of a plurality of pre-recorded video presentations representative of products and services for sale. The subscriber requests are received by a voice network interface coupled to a local area network. A plurality of data processors, typically single-board computers, capable of various tasks are operatively connected to the local area network. A number of these data processors are each dedicated to serving one subscriber during a requesting session. Others provide either navigational, subscriber, or purchase information during a subscriber session. Also coupled to the local area network is a large-scale data base which stores digital information representing the video presentations which are requested by subscribers for viewing on their televisions sets. Coupled to the large-scale data base is a means, such as a second local area network, for transmitting the digital information representing the video presentations to a CATV network for distribution to the subscriber's television set.
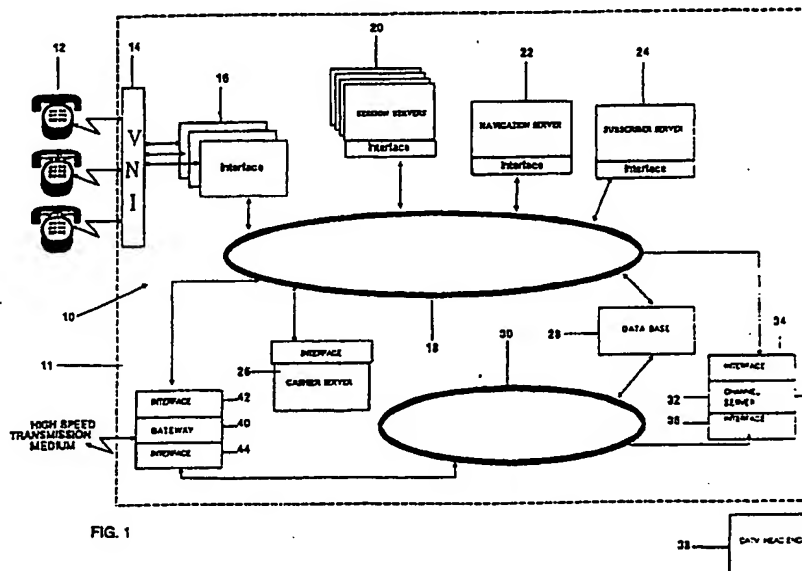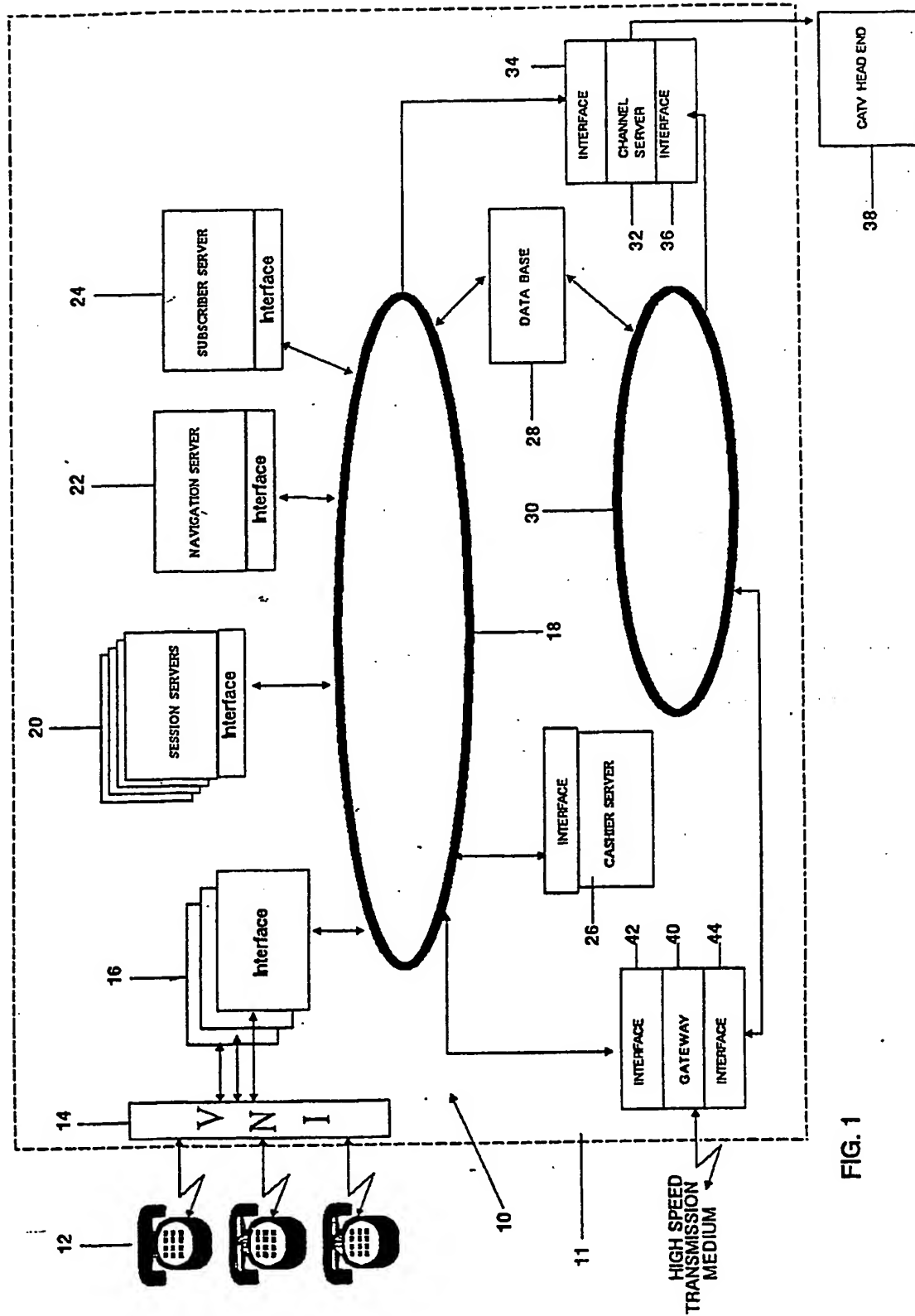

FIG. 1

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FIG. 1

A DIGITAL, INTERACTIVE COMMUNICATION SYSTEM

The present invention relates to an
digital, interactive communication system capable of
transmitting at a subscriber's request still-television
video frames, possibly with an accompanying audio

5 message, and more particularly to such a system where
video and audio information is encoded, processed and
stored in a digital format.

Conventionally, different kinds of
communication systems are used to provide voice, data,

10 and video communication services to subscribers. In
particular, interactive cable television systems have
been developed to distribute information to
subscribers' televisions at their requests. One such
system concerns a shopping service where subscribers

15 shop at home from an "electronic catalog" or in an
"electronic mall". This system is distinguished from
home shopping channels since it allows subscribers to
select which products or services they will view on
their television screens by use of touch-tone

20 telephones. Additionally, the subscriber selects the
pacing of the product or service display. In
operation, the subscriber will tune to a channel and
dial a predetermined telephone number to access the
system. As soon as the system identifies the

25 subscriber, his television screen begins to display

still-frame video, and possibly accompanying audio, and

directories of "electronic stores" comprising products

or services that may be entered or passed, examined in

further detail, saved for future consideration, or

5   purchased just by touching keys on a touch-tone

telephone in response to prompts on the television

screen. A mainframe host computer controls the flow of

information in the system.

This shopping service uses a CATV network

10   to distribute the video presentations and accompanying

audio messages requested by subscribers. At various

locations in the CATV network, a device known as a

frame store unit captures the video. Each of these

locations serves a small group of subscribers. The

15. function of each frame store unit is to capture the

video frame destined for one of the subscribers

associated with the frame store unit. The frame store

unit captures a video frame bearing its address and

converts the frame into a form it can store. Next, the

20   frame store unit determines which audio message to

associate with the video frame, bundles the audio and

video together, and injects the result into the CATV

feeder cable. The composite signal transmitted by the

frame store unit appears as a standard television

25   picture on the subscriber's television.

Other interactive cable television systems

require that each subscriber have his own dedicated

channel for viewing video and audio presentations.
Still other such systems require the subscriber view
such presentations on his own computer terminal.

Disadvantages of these earlier systems
5   include the requirement of a large mainframe computer,
and the processing of data in an analog format. The
system of the present invention provides the same
services as these earlier systems but uses a plurality
of powerful, single-board computers connected as a
10   local area network ("LAN") in lieu of a centralized
computer or mainframe computer.

In a computer network, a large number of
separate but inter-connected computers do the work of a
single centrally located computer. In any computer
15   network, the inter-connected computers are each
autonomous. Several distinct advantages are found in
using a LAN over a centralized computer system.

One such advantage concerns the relative
price of computing versus communication. Until 1970,
20   computers were relatively expensive compared to
communications facilities. The reverse is now true.
With the cost of small computers being relatively
negligible. it has become attractive to analyze the
data at the location where it originates. Analyzing
25   data at the place of origination reduces communication
costs, which now represent a larger percentage of total
cost than it did in the past.

Another advantage of computer networking is the superior price/performance ratio of small computers over large mainframe computers. Mainframe computers are approximately a factor of 10 times faste

5 than the largest single-chip microprocessor, but they cost a thousand times more than the single-chip microprocessor. This imbalance in the price/performance ratio makes it more attractive to us many microcomputers located close together (a LAN) to

10 out-perform the large mainframe computer.

In addition to a favorable price/performance ratio, LANs have other advantages over a single centralized system. For one thing, they are more reliable than a centralized computer system

15 since a single hardware or software failure in a LAN will only bring down one processor, and not affect the others.

Another major advantage of building large computer systems by coupling large numbers of small

20 processors together is the expectation of a simpler software design. In a computer network, it is possib. to dedicate some, or all, of the processors to specialized functions. That is, instead of having the processors multi-programmed, each processor does only

25 one function at any time. By eliminating the need for multi-programming, software complexities associated with the large mainframe computers are eliminated.

A further advantage of LANs is their ability to increase system performance gradually as the work load increases by merely adding more processors.

Accordingly, the major advantages of using a LAN in the system of the present invention are (1) a more favorable price/performance ratio, (2) acceptable degradation in performance upon failure of a processor, and (3) the practicality of incremental growth.

Also, the system of the present invention receives, processes and transmits data in a digital format as contrasted to the earlier systems which substantially processed data in an analog format. The advantages of a digitized system as compared to an analog system are numerous; for example, (1) equipment and circuits for digital systems have been declining in cost by a factor of two every three years for about the last twenty years, while the cost of analog circuits have not declined as fast, (2) digital signals are easier to multiplex than analog signals, and (3) digital signals, because they are represented by pulses of well defined and uniform shape, are easy to store and regenerate thereby permitting accurate reproduction of the original signals.

Thus, the use of digitally formatted signals and the incorporation of a LAN make the system of the present invention superior and more cost efficient than the earlier systems.

An object of this invention is to overcome
the deficiencies of the prior art noted above by
providing a digitized, interactive communication system
capable of transmitting to subscribers television

5   quality, still-video presentations with accompanying
audio.

It is another object of this invention to
provide an interactive communication system
incorporating the cost and performance advantages of

10   local area networks.

It is a further object of this invention
to provide a new and improved interactive communicatio
system for merchandising products and services to
subscribers.

15   The present invention is directed to a
digitized, interactive communication system capable of
being accessed by a plurality of subscribers for
generating digital information representative of
selected images in response to a subscriber's request

20   made during a requesting session. The system includes
a local area network capable of transmitting digital
information, and a voice network interface coupled to
the local area network and selectively placed in
communication with one or more of the subscribers

25   during a requesting session for receiving the
subscribers' requests and for generating digital
information representative of the identity of each

requesting subscriber and of the content of the request made by each subscriber. A data base coupled to the local area network stores in digital form the images which the subscribers can select for viewing.

5   A plurality of single-board computers are each operatively connected to the local area network. A number of the single-board computers are designated the task of being session servers. As session servers they are each dedicated to serving one subscriber

10 during a requesting session. The session servers translate the digital signals from the voice network interface to a command signal understood by the other single-board computers and transmits such command signal to the other single-board computers through the

15 local area network. At least another of the   *i* single-board computers is selectively dedicated during a requesting session to obtain biographical information relating to the requesting subscriber. Another of the single-board computers is selectively dedicated during

20 a requesting session to receive the command signal from the session server, determine which images the subscriber selected, and requests the data base to send such selected images to the subscriber. Means, such as a second local area network, are operatively coupled to

25 the data base for transmitting the digital information representative of the selected image to the subscriber. In addition, at least one other of the

single-board computers is selectively dedicated during

a requesting session for processing additional

information with request to signals generated by such

requesting subscriber.

5   For a fuller understanding of the nature

and objects of the invention, reference should be made

to following detailed description, taken in connection

with the accompanying drawing.

          FIG. 1 is a block diagram of the digital,

10   interactive communication system of the present

invention for providing subscribers with television

quality, still-video presentations and accompanying

audio.

          Referring to Figure 1, the interactive

15   cable television system of the present invention is

generally designated as 10. In operation of system 10,

a subscriber uses a touch-tone telephone 12 to

communicate with the system 10. The transmission

signals sent through telephone 12 are carried over

20   convential telephone lines to a Local Operating Center

("LOC") 11 of the system 10, which makes use of local

area network technology. At the LOC 11, the

tone-signals of telephone 12 are received by a voice

network interface 14 ("VNI"). If the tone-signals are

25   conventional voice grade transmissions, they are

transmitted to VNI 14 in analog format and are

recognized and decoded by VNI 14 to ASCII characters

recognized by an interface 16. In the instance where the tone-signals are received by VNI 14 as digital signals, VNI 14 likewise transforms the digitized touch-tone signals into a protocol recognized by

5   interface 16. VNI 14 is preferably a Summa Four, Inc., Specialty Digital Switch Model No. SDS-1000 having a predetermined number of outgoing telephone lines for bridging incoming subscriber calls to service representatives when required. Notwithstanding whether

10   the tone-signals are in digital or analog form, the output signal of VNI 14 is transmitted to a first local area network 18 ("LAN") via the interface 16. While VNI 14 is shown in Figure 1 as being located at the LOC 11, it is anticipated by the present invention that VNI

15   14 need not be co-located at the same location as LOC . 11.

The network topology of first LAN 18, that is the physical organization of the network, is known as a ring topology. A ring topology has all devices in

20   the network connected by a single communications cable that forms a circle or ring. Signals are sent from one device to another around the ring. As a signal moves around the ring, each device in the LAN electronically detects whether the message is for it. If it is, the

25   device processes the signal. If not, the device will normally regenerate the signal and transmit it to the next device in the ring.

Network access identifies the procedures
that allow each device in the network to communicate
and receive data. The network access method used in
LAN 18 is conventionally known as token passing. A
5 token is a special bit pattern that constantly travels
around the network. Every device in the network must
wait until it receives the token, before it can
transmit a message. When the device receives the
token, it transmits its message, reinserts the token ir
10 the network, which is then passed to the next device i:
the network. If a device has no message to send, it
allows the token to pass to the next device in the
network. In effect, possession of the token is
permission to transmit a message.

15 The transmission medium connecting device
in LAN 18 is preferably a baseband coaxial cable.
Baseband coaxial cable carries one signal at a time,
but the signal travels at a rapid speed--in the range
of ten million bits per second. Any of a number of
20 convential methods are used to allow many devices to
access LAN 18 concurrently.

The devices comprising LAN 18 include a
plurality of single-board computers each having a
special function in serving the subscribers, as well a.
25 a random access memory, a clock, and input/output
facilities. The single-baord computers each include
specialized application software and are associated

with an interface which connects it to LAN 18. In
addition to the single-board computers, LAN 18 further
comprises a large-scale data base 28 conventionally
referred to as a "disc farm". Stored in the data

5   base's hard disk memory units is digitized information
representing video presentations of goods or services.
Generally, these video presentations comprise
television quality, still-frame images, or textual
information , or textual information overlayed on a

10   still-frame image, or any combination of the
foregoing. These video presentations may be
accompanied by an audio message. Any of these stored
video presentations and accompanying audio can be
viewed by a subscriber upon request during any session

15   on the system 10. Also stored in data base 28 is
navigational information describing the pathways
between presentations, as well as information about
subscribers. Typically, the companies offering goods
or services to subscribers develop a structure of video

20   presentations representing an electronic store.

The single-board computers coupled to LAN
18 are manufactured by Intel Corporation of Santa
Clara, California and are designated as Model No. iSBC
36/100 or Model No. iSBC 186/100. The computers are

25   denoted according to their functional application in
the LAN 18, and are identified in Figure 1 as the
session server 20, navigation server 22, subscriber

server 24, and cashier server 26. While the servers
20, 22, 24, and 26 are each identified by a single
functional task, the present invention anticipated that
each server will have appropriate software so that the

5 server can switch functions depending on the demands on
system 10. During any subscriber session on system 10,
one session server 20 will be dedicated to serving a
particular subscriber. The number of session servers
20 at any LOC 11 will depend on the number of

10 subscribers serviced by the LOC 11. Accordingly, the
number of session servers 20 at a LOC 11 could be
anywhere in the range of 100 to 2,000 units.

The output message from VNI 14 is
transmitted through interface 16 to one of the

15 plurality of session servers 20. Interface 16
associates an incomming subscriber call to an available
session server 20. The session server 20, like all the
servers comprising the LAN 18 is itself connected to
LAN 18 by means of an interface. Though each server is

20 shown in Figure 1 as connected to an interface, in the
physical construction of LAN 18 an interface may be
shared by a plurality of servers.

Session server 20 preocesses the message
by translating or converting it into some logical

25 signal that the other servers understand, and then
passes the siganl on to LAN 18 for further processing
by the other servers. In essence, the session server

20 interprets the digital signal representing a key on the touch-tone telephone 12 and sends out a command or commands to other servers on LAN 18. Included in these commands are the subscriber's requests for selected

5· presentations.

Navigation sever 22 includes a dynamic RAM memory which can store at any instance sufficient information to enable the subscriber to move about any of the clients' presentation structures. The

10 information stored in naviagtion server 22 defines the pathways between the presentations in any presentation structure. Since navigation server 22 incorporates a dynamic RAM memory, it will only store navigation information that is useful at any particular time in a

15 subscriber session. Typically, the dynamic RAM memory of naivgation server 22 has approximately 10 megabytes of RAM memory. Thus navigation server 22 is not capable of storing all of the clients' presentation networks within its memory. This information is stored

20 in the hard disk memories of data base 28.

In operation of system 10, the subscriber designates the presentation or presentations he desires to view by depressing keys on touch-tone telephone 12. The digitized signals which represent the depressed

25 telephone keys are processed by session server 20 and are addressed to navigation server 22. Navigation server 22 fetches from data base 28 the navigational

data needed at that time to move about a presentation

network in accordance with the subscriber's requests.

Thus, for example, as the subscriber requests

information within a specific presentation structure,

5   the dynamic memory will only store navigational

information about that portion of the presentation

network that could be requested by the subscriber at

that particular time in the subscriber session. As the

session proceeds and the subscriber moves about the

10   presentation structure, the navigation information

within the dynamic memory will change with the

subscriber's movement in the structure. According to

this navigational data sotred within its dynamic

memory, and from its interpretation of the digitized

15   signals of session server 20, the navigation server 22

determines which of the presentations stored in data

base 28 hve been selected by the subscriber and

transmits a signal through LAN 18 for data base 28 to

transmit the requested presentations to the subscriber.

20   Subscriber server 24 stores information

about system 10 subscribers. The information stored

about each subscriber includes the subscriber's

telephone number, the subscriber's personal

identification number, and it identifies a presentation

25   player designated to receive the subscriber's requested

presentations. As will be explained in more detail

below, the presentation player receives, stores, and

re-transmits to the subscriber those presentations
requested by the subscriber.

Typically server 24 is active for only a
portion of any subscriber session. In the operation of
5   system 10, session server 20 queries subscriber server
24 for information concerning a subscriber. Subscriber
server 24 then fetches the requested information and
sends it to session server 20 which stores the
information in its memory. Since session server 20 is
10   active during the entire subscriber session there is no
further need to query subscriber server 24 for
information during the remainder of the subscriber's
session.

Cashier server 26 processes all
15   information concerning the subscriber's purchase of
merchandise or services. For example, cashier server
26 queries the subscriber as to the means by which he
intends to pay for purchases. If the subscriber
selects a credit card as means for payment, cashier
20   server 26 accesses the subscriber's credit card
identification number from data base 28 and transmits
an appropriate message to an authorization service so
that the pruchase is charged to the subscriber's credit
card. Another function of cashier server 26 is to
25   advise the clients of purchases so that the goods are
sent expeditiously to the subscriber.

Purchase information can be transmitted

on-line to the client or it can be stored in cashier
server 26 and "batched" to a client at a later time.
For example, all purchases made during the given period
are stored by cashier server 26 in a storage data file,
but at the end of the period they are sent in batches

5 to the various clients for further processing. Cashier
server 26 can also describe the means by which the
purchased goods will be delivered to the subscriber.
That is, it will advise the client whether the goods
are to be shipped and by which means, or whether the

10 subscriber will pick-up the goods at the client's store
              A second LAN 30, also a ring topology, is
connected to data base 28 for sending the digital
signals representing the video presentations to a CATV
system 32. Transmission of a single video frame

15 requires approximately 30 kilo-bytes to 50 kilo-bytes
of information. Since a large number of bytes of
digital information is required to represent the video
or image portion of a presentation, second LAN 30 is
needed since it accomodates a larger quantity of

20 digital information at a higher rate of speed than
first LAN 18. To meet this requirement, the
transmission medium of second LAN 30 is a broadband
medium and preferably a fiber optic cable comprising
several optical fibers having a broader bandwidth than

25 first LAN 18. Preferably, second LAN 30 is capable of
transmitting an aggregate of 40 million bytes of

information per second as compared to first LAN 18
which transmits several hundred thousand bits of
information per second.

A channel server 32 receives subscriber

5 control information from first LAN 18 and information
representative of selected video presentations from
second LAN 32 for transmission to a CATV head end 38.
Interface 34 and interface 36 repsectively couple
channel server 32 to first LAN 18 and second LAN 30.

10 Channel server 32 comprises a
microprocessor, a RAM memory of several megabytes, a
forward-error correction encoder, and a modulator. The
video, audio and control information received by
channel server 32 is converted into a high-speed

15 digital stream and modulated so that is is suitable for
transmission by a cable television network. Channel
server 32 is also schedules the order in which the
information is sent to the cable television network,
and performs forward-error correction coding to assume

20 reliability in transmission by the cable television
network.

The present invention anticipates that a
LOC 11 will service approximately 5,000 to 10,000
subscribers depending on its location. Each LOC 11 is

25 capable of communicating with other LOCs by means of a
gateway 40 which in turn communicates with a high-speed
transmission medium, such as a broadband terristal or a

communication satellite. Gateway 40 comprises a microcomputer having a memory of at least several megabytes, and is coupled to first LAN 18 and second LAN 30 by interface 42 and interface 44, respectively.

5   In communicating with other LOCs, LOC 11 can request information, such as a video presentation not found in its data base 28, and can in turn respond to the requests of other LOCs.

Although the illustrative embodiment of
10   the present invention has been described in detail with reference to the accompanying drawing, it is to be understood that the invention is not limited to this precise embodiment and that various changes or modifications may be effected therein by one skilled in
15   the art without departing from the scope or spirit of the invention. For example, while the system 10 of the present invention has been described as including a plurality of single-board computers, those skilled in the art recognize that system 10 could instead comprise
20   a plurality of multiple-board computers. Moreover, a commercial embodiment of system 10 would include a plurality of navigation servers 22, subscriber servers 24, and cashier servers 26 mounted in a housing. The exact number of these servers would be dependent on the
25   load requirements of system 10.

WHAT IS CLAIMED IS:

1. A system accessible to a plurality of subscribers for generating digital information representative of selected images in response to requests made by at least one of said subscribers

5 during a requesting session, said system comprising:

a local area network capable of transmitting digital information;

a voice network interface coupled to said local area network by means of an interface and selectively

10 placed in communication with one or more of said subscribers during a requesting session, for receiving subscriber requests and for generating digital information representative of the identity of each' requesting subscriber and of the content of the

15 requests made by each such subscriber;

a plurality of data processors, each operatively coupled to said local area network;

a data base coupled to said first local area network and having stored therein digital information

20 representative of selected images:

a number of said data processors each being dedicated to serving one requesting subscriber during a requesting session, such server data processors translate the digital signals from the voice network

25 interface to command signals understood by said other

data processors and transmits such command signals to
said other data processors through said local area
network;

at least another of said data processors being
5   selectively dedicated during a requesting session to
obtaining biographical information relating to said
requesting subscribers;

at least another of said data processors being
selectively dedicated during a requesting session to
10   receive said command signals from said server data
processor, determine which images the subscriber
selected, and request said data base send such selecte
images to the subscriber;

means operatively coupled to said data base fo
15   the high-speed transmission of digital information
representative of such selected images; and

at least another of said data processors being
selectively dedicated during a requesting session for
processing additional information with respect to
20   signals generated by each requesting subscriber.

2.   A system in accordance with Claim 1 in
which said data processors are single-board computers
having random access memory, clock and input/output
facilities.

25   3.   A system in accordance with Claim 1 in
which said data processors are multiple-board computer
having random access memory, clock and input/output
facilities.

4. A system in accordance with Claim 1 in which said images comprise still-frame video, textual information, or textual information overlayed on a still-frame video.

5. 5. A system in accordance with Claim 1 in which said selected images constitute audio, video and textual material.

6. A system in accordance with Claim 1 in which transmission medium of said local area network is

10 a baseband coaxial cable.

7. A system in accordance with Claim 1 in which the transmission medium of said local area network is a broadband coaxial cable.

8. A system in accordance with Claim 1 in

15 which said local area network is a ring topology.

9. A system in accordance with Claim 1 in which said means coupled to said data base is a second local area network used for transmitting said selected images to the requesting subscriber.

20 10. A system in accordance with Claim 9 further comprising a channel server coupled by interfaces to said first and second local area networks for transmission of control information, image information, and associated information to the

25 subscriber by means of a cable television network.

11. A system in accordance with Claim 10 in which said channel server comprises a microprocessor, a

emory, a forward-error correction encoder, and a modulator.

12. A system is accordance with Claim 9 in which said second local area network is a ring topology

13. A system in accordance with Claim 9 in which the transmission medium of said second local area network is a fiber optic cable.

14. A system in accordance with Claim 9 in which the transmission medium of said second local area network is a broadband coaxial cable.

15. A system in accordance with Claim 1 further comprising means for communicating with other like systems.

16. A system in accordance with Claim 15 in which said means for communicating with other like' systems is a gateway coupled to said system and capabl· of communication with a common-link, high-speed .transmission medium.

17. A system in accordance with Claim 1 in which said selected images include accompanying audio messages.

18. A system accessible to a plurality of subscribers for generating digital information representative of selected images in response to requests made by at least one of said subscribers during a requesting session, and system comprising:

a first local operating center serving a first group of said subscribers comprising;

a first local area network capable of transmitting digital information;

a voice network interface coupled to said first local area network by means of an interface and

5 selectively placed in communication with one or more of said subscribers during a requesting session, for receiving subscriber requests· and for generating digital information representative of the identity of each requesting subscriber and of the contents of the

10 requests made by each such subscriber;

a first group of data processors each operatively coupled to said first local area network;

. a first data base coupled to said local area network and having stored therein digital information

15 representative of selected images:

a number of said first group of data processors each being dedicated to serving one requesting .subscriber during a requesting session, such server data processors translate the digital signals from the

20 voice network interface to command signals understood by said other data processors and transmits such command signals to said other data processors through said first local area network;

at least another of said first group of data

25 processors being selectively dedicated during a requesting session to obtaining biographical information relative to said requesting subscribers;

at least another of said first group of data
processors being selectively dedicated during a
requesting session to receive said command signals fro.
said server data processor, determine which images the

5   subscriber selected, and request said first data base
send such selected images to the subscriber:

means operatively coupled to said first data
base for the high-speed transmission of digital
information representative of such selected images; ar

10   a first gateway coupled to said first local
operating center and capable of communication with a
common-link, high-speed transmission medium.

a second local operating center for serving a
second group of said subscribers comprising;

15   a second local area network capable of
transmitting digital information;

a second voice network interface coupled to
said local area network by means of an interface and
selectively placed in communication with one or more

20   said second group of subscribers during a requesting
session, for receiving subscriber requests and for
generating digital information representative of the
identity of each requesting subscriber and of the
contents of the requests made by each such subscribe

25   a second group of data processors each
operatively coupled to said second local area networ
a second data base coupled to said second lc

area network and having stored therein digital

information representative of selected images;

a number of said second group of data

processors each being dedicated to serving one

5   requesting subscriber during a requesting session, such

server data processors translate the digital signals

from the voice network interface to command signals

understood by the other of said second group of data

processors and transmits such command signals to said

10   other data processors through said second local area

network;

at least another of said second group of data

processors being selectively dedicated during a

requesting session to obtaining biographical

15   information relative said requesting subscribers;

at least another of said second group of data

processors being selectively dedicated during a

requesting session to receive said command signals from

said server data processor, determine which images the

20   subscriber selected, and request said second data base

send such selected images to the subscriber;

means operatively coupled to said second data

base for the high-speed transmission of digital

information representative of such selected images; and

25   a second gateway coupled to said second local

operating center and capable of communication with a

common-link, high-speed transmission medium for

interactive communication with said first local

operating center.